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The present invention relates to a pyrotechnic charge Basic for loading ammunition for guns, pipe guns such as bolt, howitzers, recoilless rifles and rocket launchers.

We know that arms-tube, the projectile is propelled by the pressure developed by combustion of a certain mass of propellant velocity reached by the projectile as it exits del'arme result of his leadership has been receive as a result of this combustion of the powder.
This impulse is itself proportional to the time integral of the pressure to the base of the projectile during the time of the shooting or proportional to the pressure multiplied by the average effective time of the shooting.

In practice, the combustion of the powder is very fast so that the maximum pressure is reached for a small displacement of the projectile in the tube, after which the pressure decreases rapidly despite the use of propellant called progressive.
One result is that the mean effective pressure is most often worth much less than the maximum pressure reached during firing.
The report of the average effective pressure at maximum pressure, typically called rendementpiézométrique does not exceed 0.6 in the gun tube.

However, the maximum pressure reached in a gun tube determines primarily the design and implementation of Lachambre combustion tube.
As a result, they are clearly oversized, except perhaps at the mouth, compared to the effective pressure, assumed constant, would be sufficient to print the projectile muzzle velocity identical.

We have already proposed to modify the curve of combustion of pyrotechnic charges consist of blocks of propellant by applying such blocks unrevetement combustion inhibitor partially covering their surface.
This coating allows combustion inhibitor to reduce the initial burning surface of the blocks.
However, these coatings inhibitors have a very limited duration of action compared to the total duration of combustion of propellant blocks above.
Moreover, the blocks of propellant are known for self-propelled projectiles such as rockets, with a combustion chamber at constant volume, so that the pressure during combustion is substantially constant.
This state of the art on the block of propellant above can not apply to the case loads gun tube, in which the volume of the combustion chamber, and thus the combustion pressure, are essentially variable during the travel time of the projectile in the tube.

The aim of the present invention is to overcome the disadvantages of known pyrotechnic charges for projectiles propelled gun tube, creating a pyrotechnic charge which increased the burning surface during firing can compensate for the increase volume of the combustion chamber, so that firing takes place at substantially constant pressure.

Considerable relief of the tube such weapons thus results from the change in the curve of the pressure generated during combustion of such loading, to reduce the maximum pressure so as to bring it to the average pressure effective to the projectile muzzle velocity identical.

The invention is a pyrotechnic charge elemental powder comprising a partially coated with a material inhibiting combustion.

According to the invention, the pyrotechnic charge is characterized in that the powder is an element of thin plate with respect to other dimensions, in that the combustion inhibitor coating has a set of geometric patterns that are distributed substantially on all of the at least one of the major faces of the plate powder, these units being arranged along parallel lines.

Gracie this inhibitor coating, consisting of a series of geometric patterns distributed over substantially all of at least one side of the plate powder decreases the surface initial combustion of the pyrotechnic charge for the case of a load Unpaved inhibitor combustion.

Moreover, given the geometric patterns and their distribution over almost all of the considered face plate powder, the combustion surface of the latter is changing and growing steadily almost until disposal, c that is to say, complete separation of inhibitory material combustion above the face plate powder.
Moreover, since the plate has a thin powder, which involve a short burning time, duration of action of inhibiting combustion coating extends over a significant portion of the total combustion of the plate powder.

- The burning area is growing well, it severely limits the maximum pressure of combustion and the latter is closer to the average pressure efficient combustion of the charge.
I1 follows that, for the case of the use of pyrotechnic charges uncoated conventional combustion inhibitor, can significantly reduce either the tubes propulsion gun, if the mean effective pressure is maintained, or increase the speed at the mouth of the projectile or allow the firing of a heavier projectile, if the new average effective pressure adopted is close to the maximum pressure obtained with conventional loads.

According to an advantageous embodiment of the invention, the geometric patterns of combustion inhibitors are all identical.

This provision allows you to adjust perfectly the initial surface combustion of the pyrotechnic charge and the evolution of the combustion surface during the combustion.

In a preferred embodiment of the invention, the geometric patterns are formed by elements of combustion inhibiting material deposited on at least one side of the plate powder.

Alternatively, the geometric patterns may also be formed through holes in a combustion inhibitor coating deposited on the aforementioned face plate of the powder coating deposition inhibitor combustion including such geometric patterns on the plate powder can be done through caches, stencils or perforated grids applied to the surface to be coated and coating thereof by inhibiting material applied combustion through ports caches, stencils or grids above.

Other features and advantages of the invention still in apparaieront DescriptionThis below.

In the accompanying drawings, given as nonlimiting examples - Figure 1 is a partial view, scale 10, a top plate powder coated material elements inhibitor combustion - Figure 2 is a sectional scale 30, as planII-II of Figure 1, - Figure 3 is a partial view, scale 10, a top plate powder coated with a combustion inhibitor with holes geometric - Figure 4 is unevue scale 30; along plane IV-IV of Figure 3, - Figure 5 is a view similar to Figure 1 for a variant of the pyrotechnic charge according to the invention, * - the 6 is an enlarged view relative to that of Figure 5 in section along the plane VI-VI of the Figure 5, - Figure 7 is a view similar to Figure 3 for another variant of pyrotechnic charge according to the invention, - Figure 8 is an enlarged view relative to that of Figure 7 in section along the planVIII-VIII of this Figure 7, - Figure 9 shows changes in combustion pressure versus time inside a tube of propelling a firearm, in the case of the use of loading a firearm, in the case using a conventional loading, - Figure 10 is a view similar to that of Figure 9 established in the case of using a rack of the invention

In fact, the scales which have been given are approximate.

In the embodiment of Figuresl and 2, the pyrotechnical charge for loading a basic projectile weapons for tube, such as guns or rocket launchers, includes a plate coated by powder 2 inhibitors combustion elements 3 consist of elongated rectangles .
These rectangular elements 3 inhibitor combustion are distributed over the whole of one of the major surfaces 4 of the plate powder 2.
These rectangular elements 3 inhibitor combustion are aligned along straight lines parallel elements 3 of each of these lines being offset with respect to elements 3 adjacent lines.
The three elements are a set of geometric patterns identical to each other.
In the example shown, the other large face plate powder 2 is entirely covered by a layer 6 of the combustion inhibitor.

Plate powder 2 has a thickness small compared to its length and width.
This thickness is generally less than 2.5 millimeters and preferably less than 1 millimeter.

The number of geometric patterns formed by different elements inhibitors rectangular combustion 3 is not critical.
I1 is, however, preferable that the number be greater than about 30 units per plate powder 2, so that edge effects are minimized.

The width-1 inhibitory elements of rectangular combustion 3 can be between the thickness e of the combustion plate 2 and three times this thickness.
However, this width 1 is preferably close to twice the thickness e of the combustion plate 2.
In this way, as discussed in more detail when describing the operation of the pyrotechnic charge according to the invention, the duration of action of the elements of inhibitor combustion 3 is substantially equal to the total combustion Plate 2.

The rectangular elements 3 inhibitor combustion cover between 50 and 95% of the surface of the face plate 4 of the powder 2, and preferably between 60 and 90% of the latter.

Plate powder 2 is preferably made of a homogeneous powder such as a double base propellant.
To achieve the plates of powder 2 is cut in a strip rolled and calibrated thickness by calendaring, elements of strip having the desired format for these plates powder 2.

Generally, all powders multidatabases including double-base powders (nitrocellulose + nitroglycerin + additives), and double-base composite powders (nitrocellulose + + nitroglycerin explosive or oxidizing mineral additive) can be used.
We may also use powders simple basics such as powders based denitrocellulose-containing additives.
Furthermore, the use of composite propellants (crosslinkable binder, oxidizer and mineral additives) is technically possible, but has little interest in the context of the present invention.

The rectangular elements 3 inhibitor combustion are made, preferably, from resins polyurethane chain or from polybutadiene resins silicone.
We give, below, two detailed examples of inhibitors that can be used to constitute the elements 3.

Example 1. : Inhibitor-based polyurethane - polybutadiene Hydroxy: 100 parts by weight - dialcohol achenes short: 10 parts by weight - TDI: 20 parts by weight - curing agent, anti oxidant and catalyst - containing mineral filler, for example, 50 parts iron oxide and silica.

Example 2. : Silicone-based inhibitor requiring primary membership - basic component polysiloxane: 100 parts by weight - Catalyst: dibutyl tin: 0.5 to 10 parts by weight - load borax O to 4 parts by weight - silica : 3-6% - by weight in the case of the embodiment of Figures 1 and 2, the inhibitor is applied to the combustion face 4 of the powder plate 2, through a coating deposited on the grid face 4 and having openings corresponding to the three rectangular components of combustion inhibitors.

In the case of the embodiment of Figures 1 and 2, the characteristics of the metal grid can be used as follows:
- Thickness of the grid: 0.15 mm - dimensions of the openings rectangles of equal length of the grid: A2, 70mm and width equal to 0.46 mm - distance between the rec-0, 84mm in the direction of rectangles: their-length and 0.42 mm in the direction of their width.

The ratio of the surface openings of the perforated grid above the surface of this company-estinfé than 50%, but due to the spreading of the combustion inhibitor after its filing, the area actually inhibited to 60% .

Propellant plate 2 of the pyrotechnic charge a per Figure 1, presents as an example a length of 100 mm, a width of 25 mm and a thickness of 0.4 mm.

The free surface 5 between the rectangular elements 3 inhibitor combustion is advantageously impregnated by a moderator surface.
The moderator of surface can be formed by ureas, heterocyclic ketones, camphor or ester such as dibutyl phthalate.

In the embodiment according to Figures 3 and 4, the pyrotechnic charge consists commedans.l 'exemption the previous plate powder 2.
The two faces 7 and 7a of the plate 2 are both powder coated with a layer of inhibitor combustion 8.
This layer of combustion inhibitor 8 has rectangular holes lengthened 9 aligned in parallel straight lines, which determines the thickness of a plate of combustion is equal to half the thickness of the plate.

Moreover, these rectangular holes 9 are offset from each other.
These rectangular holes 9 have dimensions substantially equal to those of rectangular elements 3 inhibitor combustion of the pyrotechnic charge shown in Figures 1 and 2.
The width of an inhibitor of combustion between two adjacent rectangular holes 9 is substantially equal to twice the thickness e of burning powder plate 2, ie equal to the total thickness of the latter .
For tailors, rectangular holes 9 of the face 7 are shifted relative to those of the other face 7a along a distance equal to 1.

In the embodiment of Figures 5 and 6, plate 2 is powder coated on its two main opposing sides, with circular elements 10 of the combustion inhibitor.
These circular elements of combustion inhibitors 10 are deposited on the plate 2 powder by coating del'inhiblteur through a perforated grid applied to the plate 2, as in the case of the embodiment of Figures 1 and 2.
The circular elements 10 of the combustion inhibitor have a diameter d which, in the example shown, is substantially equal to twice the thickness e of the combustion plate powder 2.
Moreover, the circular elements 10 of one side are offset àceuxsde the other side.

In the embodiment of Figures 7 and 8, plate 2 is powder coated on both major surfaces by a self-adhesive tape multiperforéell inhibitor combustion presented as circular holes 12.
These circular holes 12 have a diameter substantially equal to the circular elements 10 of the combustion inhibitor shown in Figures 5 and 6.

There will now be described with reference to Figures 1 and 2, the operation of the pyrotechnic charge according to the invention.

At the instant of ignition of a pyrotechnic charge, the initial surface combustion is equal to the surface of the face plate 4-poudre2 reduced by the total area of rectangular elements 3 inhibitor combustion.

After ignition, the combustion front progresses along lines courbes11 from the initial surface uncoated inhibitor of combustion (see Figure 2).
We see, according to al-lure courbes11 lines, the combustion surface increases steadily from ignition until the complete combustion of the powder plate 2, the thickness of combustion is equal to thickness of the plate.
Since the width of a rectangular elements 3 inhibitor combustion is substantially equal to twice the thickness of th combustion, combustion fronts defined by lines courbesli between two rectangular 3 inhibitor combustion neighbors joined along the lines courbes11 reach 6dtinhibiteur continuous layer deposited on the combustion side of the plate 2 opposite face 4 with the elements 3.

Therefore, the inhibitory action of rectangular elements 3 is extended for the duration of burning powder plate 2 so that the combustion surface of the growing dernièréest.régulièrement throughout its burn time.
Given that during this combustion, the volume of the combustion chamber defined within the barrel increases, due to the advancement of the projectile, it significantly reduces the gap between the initial and maximum pressure mean effective pressure of combustion.
It is thus possible to reduce considerably the construction of gun barrels, rocket launchers, howitzers or similar weapons, relative to that of the tubes using conventional pyrotechnic charges in uncoated plates or similar combustion inhibitor impregnated surface or possibly by Moderators combustion.

The fact that the elements 3 inhibitors are a combustion repetitive geometric pattern, greatly facilitates the application of the inhibitor on the combustion plate.

powder 2.
Moreover, the distribution and spacing of these inhibitors regular 3 facilitate the ignition of the powder plate 2 and ensure that all combustion fronts converge simultaneously at the end of combustion.

The evolution curve of the combustion pressure generated inside the barrel of the firearm can be changed at will, in particular to reduce the gap between the maximum pressure and mean effective pressure, varying the ratio of the initial surface combustion on the combustion surface finish, that is to say acting on the report on surfacerion-inhibited total area of the plate powder 2.
In the case of the embodiment of Figures 1 and 2, this ratio can be greater than 4.

Tests have shown that best results are obtained when the total area of combustion inhibitors elements 3 distributed on the face plate 4 of the powder 2 is between 50 and 95% of the surface of the plate and preferably between 60 and 90% of the latter.

I1 is possible to significantly increase the progressivity of the instantaneous combustion surface by providing a inhibage part on the two major opposing faces 7 and 7a of the plate powder 2, as shown in Figure 4.
In this case, we can get a report of escalation between 4 and about 8.

Such a high proportion could never be achieved by implementing techniques prior to the present invention.

The functioning of the pyrotechnic charges shown in Figures 5-8 is identical to that of the embodiments described with reference to Figures 1 to 4.
However, in the case of circular elements 10 of the combustion inhibitor, as shown in Figures 5and. 6, it is possible to achieve very significant escalation of the surface instantaneous combustion.

Figure 9 shows, for example, the evolution curve of the pressure inside a gun barrel recoilless function of time during the propulsion of a shell formed by a conventional loading for example by small cylinders of 19 holes drilled powder and impregnated by a moderator surface.
This curve shows quel'on reaches a few moments after lighting a maximum pressure exceeding 300bar very high.
This pressure then falls rapidly, so that there is a considerable gap between the maximum pressure and mean effective pressure of combustion.

Figure 10 shows an example comparison of the evolutionary ion pressure versus time is obtained in the case of a load consisting of pyrotechnic charges elementary slabs according to the embodiment of Figures 5 and 6.
It is seen from this example that the combustion pressure is virtually constant over most of the burning time.
Moreover, this pressure does not exceed 150 bar.
Therefore, the maximum pressure almost coincides with the average effective pressure.
I1 is therefore possible to reduce considerably the construction of the tubes of guns such as gun barrels, since these tubes are subjected to a pressure significantly lower than that prevailing in the tubes using conventional fillers.

Bienenterldu, the invention is not limited to that described above and can be made to these denom-many modifications without departing from the scope of the invention.

Thus, although this is of limited technical interest, one of the great sides of the plate powder 2 can be totally devoid of inhibitor combustion.

On the other hand, the rectangular combustion inhibitor 3 or circular elements 10 can be replaced by patterns of any shape, such as triangles, hexagons, etc..
Moreover, these 3 or 10 may still be replaced by narrow bands of inhibitor combustion extending along the length or width of the plate 2, or a combination of different basic patterns.

The dimensions of the plate 2 may be any powder, provided that its thickness is small (short-term combustion), so that the action of inhibitory elements for combustion is sensitive for almost all the time this combustion.

The functioning of the pyrotechnic charge Basic according to the invention is independent of the mode of loading them.
Indeed, these plates powder 2 may consist of small pads placed in bags in bulk fuel in order to build cartridges for howitzer.

Lesplaque powder may still be cut to be arranged in the form of loading washers stacked and braced.
In addition, sheets of powder can still be rolled into a spiral.